

The McGill Centre for Microbiome Research Year 3 Narrative Report

Reporting Period: April 15th, 2021 – April 15th, 2022

Lead Investigator: Dr. Irah King and Dr. Ken Dewar

The two MI4 supported platforms are now coordinated within the McGill Centre for Microbiome Research. Specific milestones and deliverables for each platform are marked as [Gnoto] or [Genome]. Progress towards Annual Milestones and Deliverables of both platforms:

The McGill Centre for Microbiome Research has experienced significant progress over the past year. While we were able to finalize overarching components of our operations, by training additional technical personnel and launching our website, we’ve also completed a significant number of key research objectives and studies. Furthermore, as we synergized efforts and expertise, we’ve developed a research pipeline between both platforms, one of our milestones initially planned for our fourth year of activity. Below are the details of last year’s deliverables.

	Annual Milestones and Deliverables (from proposal)	Description of Progress
1	[Gnoto] Determine per diem rates for axenic CL1 animal studies	Based on our occupancy data and related fees for human and infrastructure resources, we were able to determine a competitive per diem rate of 6.50\$ for our clients compared to the current rate of similar North America institutions (e.g. McMaster University which charge over 7\$/day). The financial analysis leading us to this rate shows that it should foster research and allows us to become financially sustainable with regular customers and successive projects from different research groups throughout the year.
2	[Gnoto] Establish an online database for storage of information related to technical services rendered, reagent inventory and maintenance of platform operations	All service requests, material inventory and purchases, financial reports/transactions and operation and maintenance documentation are centralized and kept by the program manager, Ms. Cynthia Faubert.
3	[Gnoto][Genome] Establish a scientific advisory committee that reviews platform operations (e.g. space efficiency, SOPs, budget, etc.) on an annual basis	Due to the activity delays incurred at the beginning of last year’s reporting period, we did not reach the expected level of growth for the creation of this structure and therefore did not accomplish this deliverable. Now that we have been approached by several clients in the last couple of months for Gnotobiotic platform



		<p>services and are building a consistent client load with the Microbial Genomics platform, we determined appropriate candidates and invited them on March 31, 2022 to participate in our external advisory board. We have already secured three members:</p> <p>Dr Elena Verdu (McMaster University) Dr Rana Samadfam (Charles River Laboratory) Dr Colin Hill (University College Cork)</p> <p>We are awaiting responses from the other candidates and aim to have a complete committee in place by May 1, 2022.</p>
4	[Gnoto] Expand QC Program for performing CL2 studies	<p>Since the last reporting period, we successfully hosted four CL2 experiments with significant results to be used for further projects and publications. Furthermore, these experiments were performed in parallel with our operations involving germ-free mice. Not only were we able to maintain the status of our germ-free animals for over 6 months, but no contamination has been detected since platform launching despite the numerous equipment issues last year.</p>
5	[Gnoto] Research milestone: Successfully maintain a line of mice monocolonized with a defined bacterial species for 3 months	<p>The development of our in-housed colony is, among other research objectives, meant to serve this purpose. As we successfully implemented our breeding program, and were able to use offspring for an experiment, we momentarily suspended our production to prioritize our clients' experiments. However, the financial analysis related to this service has already been completed and we've established a competitive reduced cost for mouse purchase (120\$/mouse) compared to commercial vendors (318\$/mouse). We now have ongoing breeding since March and a part-time dedicated animal health technician, made possible by our partnership with Animal Resources Division at the MUHC-RI, to manage our animal inventory. Regarding planned colonization studies, bacterial species will be grown internally in close collaboration</p>

		with the Microbial Genomics platform which will serve both platforms' objectives.
6	[Genome] Implement cost models for microbiology fee-for-service activities (DNA extractions, direct colony PCR, bacterial load estimation, gnotobiotic mouse sterility testing)	<p>With the support and partnership of the McGill Genome Centre (MGC), we are currently finalizing our fee-for-service offer to integrate the platform activities within the MGC financial system Hercules.</p> <p><u>Cost models completed or in progress include:</u></p> <ul style="list-style-type: none"> • small scale DNA extractions (1-24 samples) • large scale DNA extractions (48+ samples) • mouse sterility testing • direct colony PCR • culturing and quantitation (bacterial load) <p><u>Cost models under development for the upcoming year:</u></p> <ul style="list-style-type: none"> • bacterial strain repository <p>With these cost models, all microbiology, genomics and bioinformatics work activities will now be fee-for-service.</p>
7	[Genome] Benchmark studies of sample collection and storage conditions.	<p><u>Benchmarks studies completed include:</u></p> <ul style="list-style-type: none"> • daily variation and reproducibility of human fecal samples • assessment of different DNA extraction protocols • effect of 4 degrees C storage on cell viability and DNA integrity <p><u>Benchmark projects for the coming year include:</u></p> <ul style="list-style-type: none"> • effect of multiple freeze/thaw cycles on cell viability and DNA integrity • organizing and displaying benchmarking results on our website
8	[Genome] Full microbiome sequencing cost reduction.	<p>Our cost reduction efforts have been focused on genomics applications in collaboration with the McGill Genome Centre.</p> <p><u>16S PCR amplification and sequencing:</u> reproducibility and streamlining of protocols has led to reductions in QA/QC steps.</p>



		<p><u>Whole genome sequencing</u>: pilot experiments for sequencing libraries with reduced consumables were shown to be less robust and required higher rates of re-work. Returning to full scale library preps has led to other savings due to batch QA/QC steps.</p> <p><u>Reducing turnaround time</u>: this remains a major challenge but is already improving due to a higher number of larger scale projects (minimum ½ sequencing run per project).</p> <p><u>16S bioinformatics analysis</u>: improvements to the generation of Amplicon Sequence Variant (ASV) results have reduced turnaround time and delivers more refined analyses.</p> <p>In the upcoming year, we will evaluate our new cost models to identify opportunities for cost reduction.</p>
9	[Genome] Automated processing of 16S sequencing data into ASV tables (amplicon sequence variants and their counts).	<p>Completed.</p> <p>The next round of improvements will incorporate changes in relative frequencies in addition to absolute counts.</p>
10	[Genome][Gnoto] Web portal development and implementation.	<p>The website launching has been an important achievement for the Centre, which started with a logo contest within the McGill community last Fall. After building content and structure with the support of McGill IT and Communications, the website is live since March 21st. It already has been promoted on Twitter and the RI-MUHC website. The Centre website displays the interconnectivity of both platforms, but also shows their own specificities, services and collaborators. It will be continuously improved and updated and will also promote news, events and partner groups such as the McGill Centre for Antimicrobial Resistance. Social medias profiles are to be soon launched as we have initiated discussion with the McGill Communications department to optimize our visibility and the consolidation of our website with our future social media</p>



		<p>accounts. Here is the URL of the Centre website:</p> <p>https://www.mcgill.ca/microbiome-research-centre/</p>
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Plans and updated Milestones for the next reporting period: (April 15th, 2022 – April 15th, 2023)

- [Centre]: Become a McGill Senate-approved, full status Centre
- [Centre]: Increase Centre membership by 10%
- [Centre]: Organize a two-day research symposium including external advisory board members, slated for Dec. 1-2, 2022.
- [Gnoto] Research milestone: Successfully maintain a line of mice monocolonized with a defined bacterial species for 3 months.
- [Gnoto] Enhance the accessibility of our services to customers; connect the platform on iLab, develop a subpage on RI-MUHC technology platform website and create a survey for users to provide feedback regarding the platform services.
- [Gnoto] Develop an incentive program (i.e. reduced fees) for pilot experiments.
- [Gnoto] Research milestone: Successfully complete independent CL1 and CL2 studies by three research groups and/or maintain an annual average of 30% of total housing capacity.
- [Genome] Improve the turnaround time following the requests submission from clients by optimizing the samples processing work methods.
- [Genome] Finalize the purchase and the installation of the anaerobic chamber at the Duff.
- [Genome] Develop and test anaerobic protocols, calculate costs models, introduce anaerobic culturing as fee-for-service.
- [Genome] Increase salary contribution to the McGill Genome Centre to improve data quality and turnaround time.
- [Genome] Our internal strain repository currently contains over 1350 isolates from over 135 species. In the upcoming year, we will publicize this on our website and evaluate levels of interest from clients.
- [Genome][Gnoto] Establish a scientific advisory committee that reviews platform operations on an annual basis.

List of Personnel involved in the Centre and Description of Roles:

- Dr. Irah King: director of the McGill Centre for Microbiome Research, director of the Gnotobiotic Animal Research Platform
- Dr. Corinne Maurice: assistant director of the McGill Centre for Microbiome Research
- Dr. Ken Dewar: director of the Microbial Genomics platform
- Dr. Benoît Cousineau: associate director of the Microbial Genomics platform
- Dr. Jesse Shapiro: associate director of the Microbial Genomics platform
- Ms. Caroline Monat: microbiology lab technician of the Microbial Genomics platform
- Dr. Emmanuel Gonzalez, Romain Gregoire, Francoise Lefebvre, Xiaomeng Jiang: bioinformatics and web site development
- Mr. Antoine Paccard: project manager for the Microbial Genomics platform (MGC)
- Ms. Janick St-Cyr: sequencing laboratory manager for the Microbial Genomics platform (MGC)

- Dr. Pierre Lepage: sequencing laboratory supervision and 16S protocol optimization for the Microbial Genomics platform (MGC) (retired as of February 2022)
- Mr. Pouria Jandaghi: high-throughput DNA extractions for the Microbial Genomics platform (MGC)
- Ms. Tania Younes: financial project manager, financial advisor for the Microbial Genomics platform (MGC)
- Ms. Cynthia Faubert: program manager of the McGill Centre for Microbiome Research

Challenges and Lessons Learned:

- [Gnoto] [Genome] Partnerships with other McGill entities, while working to optimize existing structures and initiatives, make us vulnerable to inconsistent growth due to the coordination needed with unforeseen situations. Having raised a similar concern in last year's report, on the importance of a contingency plan, we have trained additional personnel in both platforms to mitigate activity delays. However, it is obvious that synergy with our collaborators will remain a challenge to manage for the next phases of our development.
- [Gnoto][Genome] Although our website is live and promoting our platform operations, the Centre must be constantly innovating to maintain visibility and the interest of the research community. Outreach and promotion of our initiatives have to be integrated within a defined and efficient communications strategy.